April 2002 Volume XXXIV, Number 2

Tsunami Newsletter

INTERNATIONAL TSUNAMI INFORMATION CENTER - ITIC

SUMMARY OF PACIFIC BASIN EARTHQUAKES

Occurring February-March 2002

With surface wave or moment magnitudes greater than or equal to 6.5, with a depth no greater than 100 km, or an event for which a TIB or RWW was issued. Epicenter and Mw from USGS/NEIC (G), preliminary Ms from PTWC at time of action, Mw and depth from Harvard (H).

DATE	LOCATION	TIME (UTC)	LAT.	LONG.	DEPTH (km)	Ms	Mw	PTWC ACTION	ACTION (UTC)	Damaging Tsunami ?
5 March	Mindanao, Phillippines	21:16	6.171 N	124.284 E	45	6.8	7.2 (G) 7.5 (H)	TIB	21:41	yes
26 March	Southwestern Ryukyu Islands, Japan	03:46	23.466 N	124.063 E	33	6.6	6.4 (G,H)	TIB	04:17	no
31 March	Taiwan Region	06:53	24.477 N	122.203 E	33	7.3	7.1 (G,H)	TIB	07:21	no

TIB=Tsunami Information Bulletin

5 MARCH 2002 21:16 UTC MINDANAO, PHILIPPINES

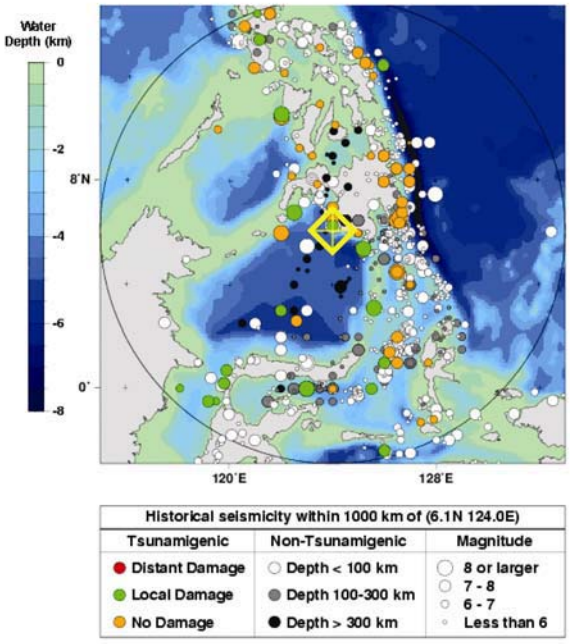
SOUTHERN MINDANAO EARTHQUAKE GENERATES LOCAL TSUNAMI

Compiled from reports from Dr. Raymundo Punongbayan, Director, Philippine Institute of Volcanology and Seismology, and ITSU National Contact

Small-level, local tsunamis affecting the towns of Palimbang in Sultan Kudarat province, and Maitum and Kiamba in Sarangani province, were generated by the 2116 UTC 5 March 2002 earthquake in the southern Philippines [see map on Page 2]. These localities are difficult to access, and more accurate reports are not available. Credible reports from residents in coastal towns and villages observed the sea receding 50-150 meters from the shore almost immediately after the earthquake. A 150-m recession and estimated 3-m high wave, was reported by General Magsino, a participant in the US-RP "Balikatan" Exercise, who ordered everyone to immediately evacuate to high ground. Two boats were damaged when the waves returned after a few minutes. In Maitum, the sea receded 300 m from the shore and the onrushing waves destroyed a pump boat; dead fish were observed soon after. In Kiamba, the sea receded 5-8 m and then rose back again, and people fled to the mountain. Subsequent tsunami modelling in collaboration with JICA expert Dr. Yuchiro Tanioka predicted 3-m high tsunami in Palimbang followed by a recession a minute after the earthquake, which were consistent with eyewitness accounts and damage reports.

5 March 2002 21:16 UTC Mindanao (Continued)

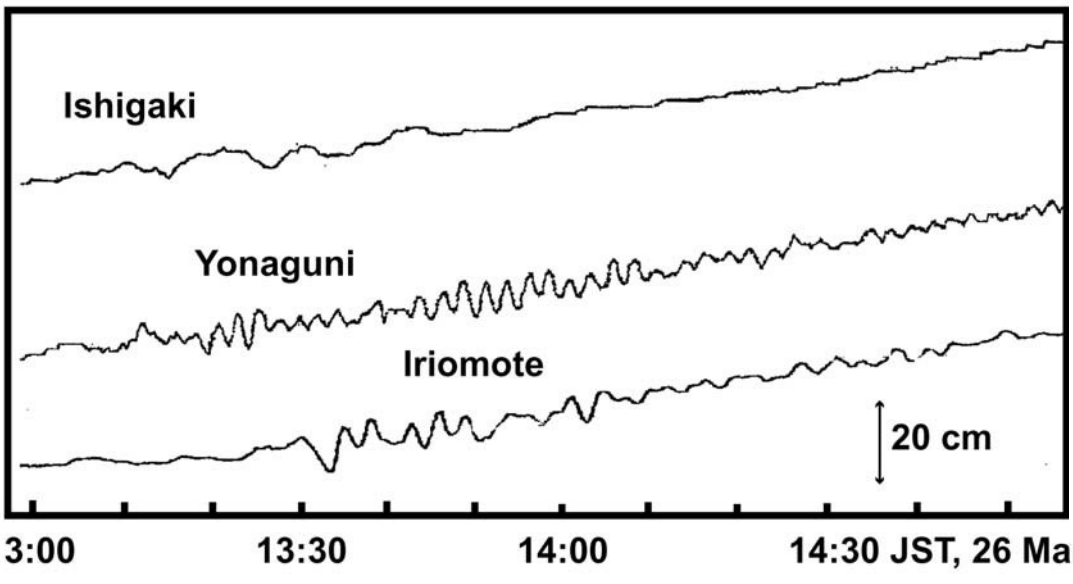
The major thrust earthquake occurred at about 38-km depth along the Cotabato Trench in the Celebes Sea where the Philippine Sea Plate subducts beneath the overlying Sunda Plate. The early-morning earthquake killed 15 people, injured more than 100, and destroyed and damaged buildings throughout southern and central Mindinao island. The earthquake was the strongest to hit the Philippines since 1990 when a M7.8 earthquake killed 1621 people on Luzon island to the north. The last major earthquake in Mindanao occurred in 1976 when a M7.9 earthquake in Moro Gulf resulted in about 8000 fatalities, including about 4000 killed as up to 5-m high tsunami waves devastated the coastlines around the Gulf.



The yellow diamond in the map above, indicates the 5 March Earthquake

Map showing places mentioned in Dr. Raymundo Punongbayan's report

26 March 2002 03:46 UTC Ryukyu Islands



Tide records from three stations where waves were noticeable (see map on Page 9). The Ishigaki (24°20' N, 124°09'E) and the Yonaguni (24°27' N, 122°57' E) tide records are from Japan Meteorological Agency stations (JMA). The Iriomote (24°23' N, 123°45' E) station record is from Geographical Survey Institute of Japan (GSIJ). Thanks to Michio Takahashi of JMA and ITSU national contact, for making them available to ITIC.

(continued on Page 9)

DART BUOYS PROVIDE REAL-TIME REPORTING OF TSUNAMIS

Summarized from International Tsunami Symposium 2001 Proceedings
E N. Bernard, F. I. Gonzalez, C. Meinig, and H. B. Milburn, Early Detection and Real-Time Reporting of Deep-Ocean Tsunamis, NTHMP Review Session, Paper R-6
M. C. Eble, S. E. Stalin, and E. F. Burger, Acquiistion and Quality Assurance of DART data, Session 5, Paper 5-9

The Deep-ocean Assessment and Reporting of Tsunamis (DART) Project is an ongoing effort of the U.S. National Tsunami Hazard Mitigation Program (NTHMP) to develop and implement a capability for the early detection and real-time reporting of tsunamis in the open ocean. Project goals are the reduction in loss of life and property in U.S. coastal communities, and the elimination of false alarms. A network of real-time reporting DART buoys sited in regions where great earthquakes can potentially generate destructive tsunamis was conceived to provide timely warnings to at-risk communities. (Figure 1). The siting of buoys ensured the detection of tsunami within these regions within 30 minutes of the generating earthquake, followed by the immediate relay of the tsunami data to the warning centers and the states.

Bottom Presssure Recorders (BPR's) developed at the National Oceanic and Atmospheric Administration (NOAA) Pacific Marine Environmental Laboratory (PMEL), and used for over a decade to measure and record tsunami amplitudes of less than 1 cm in the open ocean, are the foundation of the DART system. DART development required the sustained efforts over the past five years of over 25 scientists, engineers, technicians, and software developers. The NTHMP provided about US $3.6 million of the US $6.2 million, including ship time, required for development and implementation.

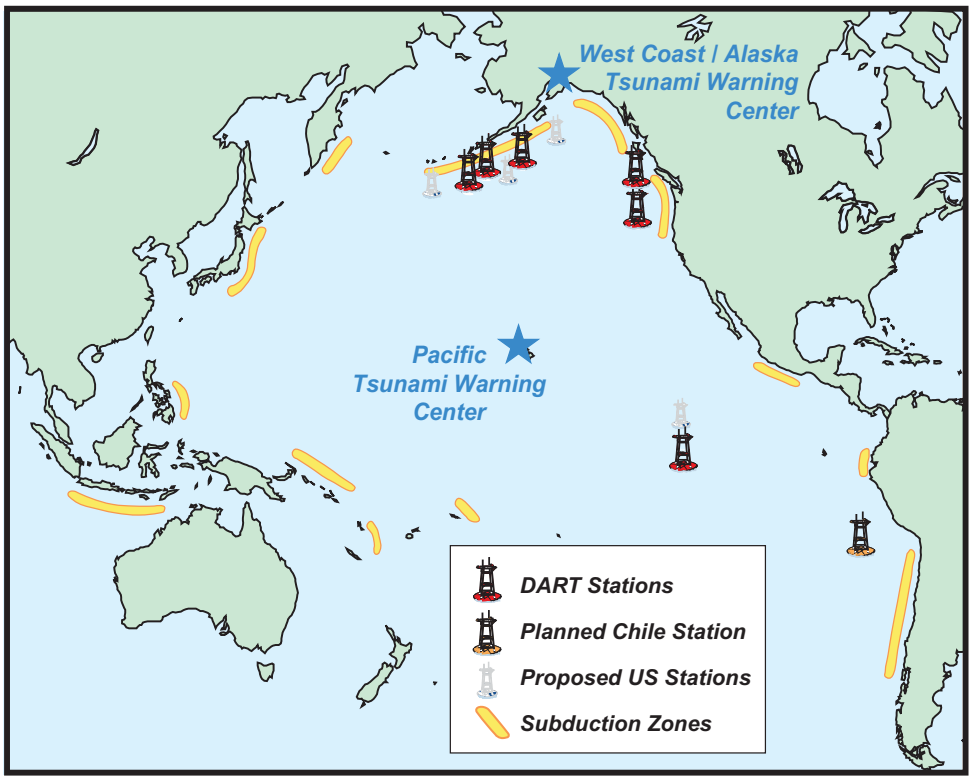


Figure 1. Locations of the DART real-time reporting buoys, including the planned cooperative US/ Chile buoy off Iquique, Chile. The locations of subduction zones where large earthquakes have produced significant Pacific-wide tsunamis are shown in yellow.

Although there has been no detected tsunami generated since the array has been installed, end-to-end tests of each DART system have been conducted in-situ, with pre-programmed, artificial signals used to trigger the initiation of the tsunami reporting mode. Additionally, DART stations have been triggered into tsunami reporting mode on several occasions when seismic surface waves from local earthquakes have imparted vertical acceleration to the BPR that induced an apparent change in pressure.

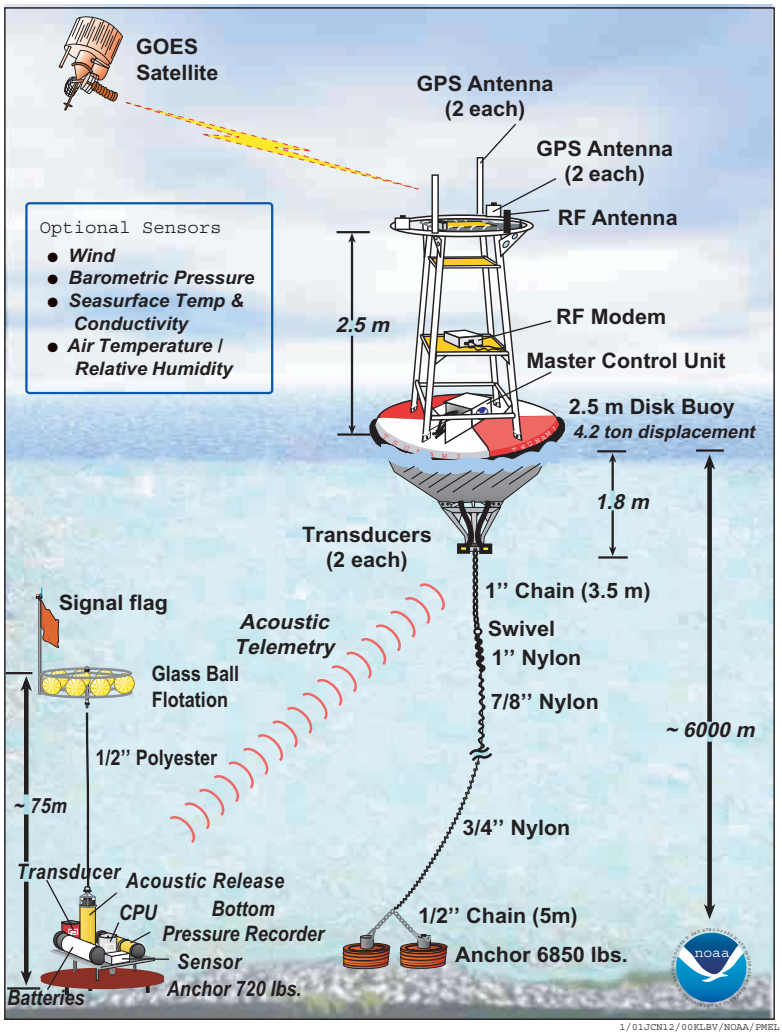


Figure 2. Schematic of the DART mooring system showing the coupling between the bottom pressure recorder package and the surface buoy anchored nearby.

DART Data Acquisition and Dissemination

A DART mooring system consists of an anchored seafloor package and a moored surface buoy for real-time communications. Each seafloor system couples acoustic modem technology with bottom pressure recorders capable of detecting and measuring tsunamis with amplitude as small as 1 cm in 6000 m of water. The BPR uses a pressure transducer to make 15-s averaged measurements of the pressure exerted on it by the overlying water column.

An acoustic link is used to transmit the BPR data from the seafloor system to its accompanying DART surface buoy. The commercially-available modem pairs are technologically similar to the familiar telephone-based computer modem.

The GOES Data Collection System (DCS) is used to transmit data in near real time. The GOES DCS is a communications system that uses a transponder carried on the GOES spacecraft to relay UHF transmissions from data collection platforms by S-band to properly equipped ground receiving stations. Once data are relayed to the ground stations, the signals are demodulated and immediately disseminated to NOAA's Tsunami Warning Centers in Alaska and Hawaii, and to PMEL for quality control.

A DART system operates in two modes. Tide mode provides 15-minute data every hour to verify that the system is operating properly. The detection algorithm running in the BPR generates predicted water height values and compares all new data samples with the recently predicted values (Mofjeld, http://www.pmel.noaa.gov/tsunami/tda_documentation.html). If two 15-s water level values exceed that predicted by a preset cutoff threshold, typically 1-3 cm, the system will go into Tsunami mode. In Tsunami mode, high frequency data are transmitted at short intervals on the random channel for a minimum of three hours. During the first hour, the BPR sends 1-min data, comprised of the average of four 15-s values, for the preceding two hours (120 values). This redundant transmission scheme ensures the receipt of all data during an event. If the ocean is still perturbed after the nominal 3 hours of the Tsunami mode, the hourly self-timed transmission of 120 1-min averaged values will continue. The system returns to normal tide-reporting mode only after 3 hours of undisturbed water heights.

The DART Data Quality Control web page (http://tsunami.pmel.noaa.gov/dartqc/WaveWatcher) is accessible to all interested parties, including State officials and the Tsunami Warning Centers. Tsunami Warning Centers, however, rely on separate, dedicated data streams to acquire their operational data.

(continued on Page 7)

ITIC NEWS

Experts Meeting on Early Warning and Sustainability. The German Committee for Disaster Reduction invited the ITIC Director to participate in an Experts Meeting in Bad-Honnef, Germany, March 11-12, 2002, to assist in developing an input paper on 'Early Warning and Sustainability' for the World Summit on Sustainable Development to be held in Johannesburg, South Africa, September, 2002. The ITIC Director contributed expertise on successful rapid early warning systems for tsunami detection and warning currently in operation nationally and internationally.

ITIC-IOC-ICG/ITSU Meeting. ITIC Director Laura Kong met with UNESCO/IOC Ocean Services Head Peter Pissierssens and ICG/ITSU Chair François Schindelé on March 14-15, 2002, at UNESCO headquarters in Paris, France. Discussions focused on the agenda for the upcoming Visiting Experts Program (May 28-June 11, 2002), which will be held in conjunction with the Tsunami Symposium in Honolulu, Hawaii at the end of May, implementation of a ITIC-ICG/ITSU Tsunami Information Portal to be modeled after the IOC Ocean Portal dynamic content management system, planned improvements in content and graphics quality to the ITIC Tsunami Newsletter (planned to be printed in-house and in color), the 2002 ITIC budget, and NOAA/NWS/ITIC's printing a third English edition of the *Tsunami, The Great Waves* brochure this Spring.

PTWC NEWS *Submitted by Dr. Charles McCreery, Director of PTWC*

Caribbean Tsunami Warning System. McCreery attended the Seventh Intergovernmental Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE) held February 25-28, 2002 in Veracruz, Mexico. He presented the Intra-Americas Sea Tsunami Warning System Project Proposal on behalf of the IOCARIBE Tsunami Steering Group of Experts and the IOC International Coordination Group for the Tsunami Warning System in the Pacific (ICG/ITSU). This proposal was developed over the past six years as a result of three workshops in the Caribbean region, and the efforts of the IOCARIBE and ICG/ITSU and their Member States. The proposal was endorsed by the meeting and adopted as an SC-IOCARIBE-VII Recommendation. It will now be sent to the IOC Executive Council for their approval and to seek funding for implementation.

New Pacific Seismic Data. Contractors representing the Incorporated Research Institutes for Seismology (IRIS) and its Global Seismic Network spent a week at PTWC in early February. They worked with PTWC and other U.S. National Weather Service staff to activate a satellite link for receiving high quality real time broadband seismic data from a new station at Pitcairn Island in the southeast Pacific. These data are now being utilized in PTWC operations as well as forwarded to IRIS. The satelite link will also be used for up to an additional nine Pacific stations, most of which are at remote island sites without any other feasible communications means. When the project is completed it will provide both U.S. Tsunami Warning Centers (PTWC and WC/ATWC) with an independent non-land-line data set sufficient for locating and evaluating potentially tsunamigenic earthquakes in the Pacific.

Enhanced Backup Capabilities. PTWC and the West Coast/Alaska Tsunami Warning Center (WC/ATWC) have focused efforts over the past few months to improve backup capabilities between the Centers. The two Centers have exchanged and implemented each other's messaging software and have also been issuing monthly communications tests over the various messaging circuits to each other's area of responsibility. These efforts help ensure that tsunami warnings and other bulletins can be issued normally under the circumstances that either Center is partially or completely disabled.

NATIONAL CONTACT UPDATES

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CONFERENCES

April 16-17, Alaska Emergency Management Conference: Earthquake and Tsunami Awareness . A team of earthquake and tsunami experts, both local and from out of state, will present their lessons learned and offer planning and mitigation techniques to help all of Alaska plan for the next potentially disastrous event.

May 28-30, 2nd Annual Tsunami Society Tsunami Symposium. East-West Center, University of Hawaii, Honolulu, Hawaii. Registration forms and more information can be found at http://www.sthjournal.org/stsa.htm. For additional information call Mr. George Curtis, 808-963-6670, e-mail gcurtis@hawaii.edu, or Dr. Barbara Keating 808-956-8143, e-mail keating@soest.hawaii.edu. In addition to the General Session the conference will include a session on the National Hazard Mitigation Program, chaired by Eddie N. Bernard of PMEL, and a workshop chaired by Barbara Keating of University of Hawaii. A field trip is also planned.

July 9-12, Western Pacific Geophysics Meeting 2002, Wellington, New Zealand. Ocean Sciences Special Session #10; Tsunami, Storm Surge, Relative Sea-Level and Coastal Change, A special session proposed by A.C. Hinton (a,b) and W.P. de Lange; (a) Department of Earth Sciences, University of Waikato, Private Bag 3105, Hamilton, New Zealand, (b) School of Geography, Leeds University, Leeds, LS2 9JT, U.K. Email: a.c.hinton@leeds.ac.uk or w.delange@waikato.ac.nz See http://www.agu.org/meetings/wp02top.html for details of the meeting and abstract submission deadlines.

August 14-15, The 5th New Zealand Natural Hazards Management Conference 2002 Te Papa, Wellington, New Zealand. The Institute of Geological and Nuclear Sciences (GNS), the National Institute of Water and Atmospheric Research (NIWA), Ministry of Civil Defence and Emergency Management, Wellington City Emergency Management Office, Wellington Regional Council, and the Earthquake Commission (EQC) invite you and your colleagues to participate in the 5th New Zealand Natural Hazards Management Conference in August 2002. The conference will provide a forum to discuss the integration of hazard information into effective risk management, including: Applying hazard information to best practice planning, Exploring new technologies - advances in science application, Natural hazard mitigation for industry, Creating resilient communities through integrating science and practice. Registration and programme details will be sent out late May 2002. This information is taken from http://www.gns.cri.nz/news/conferences/hazconf2002.htm. For further information please contact: Diane Tilyard, Wairakei Research Centre, Institute of Geological & Nuclear Sciences, Private Bag 2000, TAUPO New Zealand. Phone: (07) 374 8211 Fax: (07) 374 8199 or Email: d.tilyard@gns.cri.nz.

August 15-17 (Thursday-Saturday) Harbin, China and **August 19-20** (Monday and Tuesday), Hong Kong, **International Conference on Advances and New Challenges in Earthquake Engineering Research (ICANCEER-2002).** Sponsor: Asian-Pacific Network of Centers for Earthquake Engineering Research (ANCER - a new consortium committed to enhancing research, education, and technology transfer to reduce seismic hazards). The event will have two consecutive back-to-back meetings in different locations. For Harbin conference, contact: Xiaozhai Qi, Institute of Engineering Mechanics, China Seismological Bureau, 9 Xufu Road, Harbin 150080, China; tel: 86-451-665-2625; fax: 86-451-666-4755; e-mail: qxz@iem.net.cn/ or qxz@public.hr.hl.cn . For the Hong Kong conference, contact: Jan-Ming Ko, Faculty of Construction and Land Use; The Hong Kong Polytechnic University; Hung Hom, Kowloon, Hong Kong; tel: 85-227-665037; fax: 85-223-622574; e-mail: cejmko@polyu.edu.hk. For both conference programs, registration, and other information, visit http://www.nd.edu/~quake/ICANCEER/.

September 2 - 7, "Holocene environmental catastrophes and recovery" Brunel University, West London. Co-sponsored by Brunel University, INQUA and PAGES. An inter-disciplinary conference on past geological and environmental catastrophes, and their impact on our society. This conference will involve not only the Quaternary community but also biologists, archaeologists, historians and economists. An informal pre-conference fieldtrip is planned that will examine evidence for past environmental catastrophes in the Scottish Highlands (post-glacial large-magnitude earthquakes; glacial megafloods; Storegga-Slides tsunami event; human impacts of Icelandic volcanic catastrophes; environmental disturbances in Loch Ness). Further details are available from Suzanne Leroy at Brunel University, UK (suzanne.leroy@brunel.ac.uk). *(continued on Page 10)*

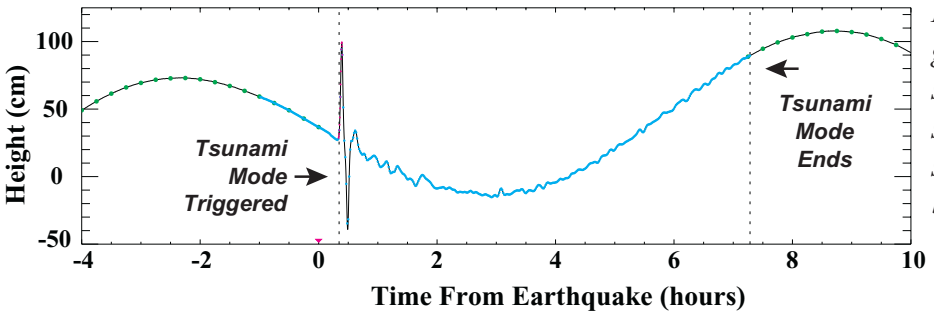


Figure 3. An artificially generated tsunami signal superimposed on a synthetic time series illustrates the sampling scheme and the transitions between tide and event modes.

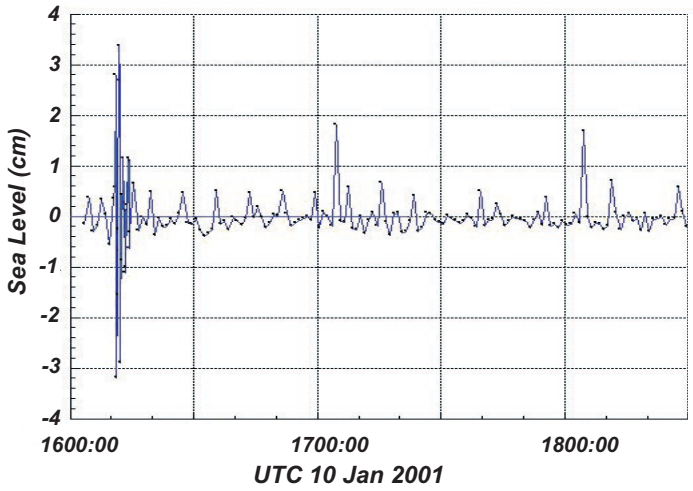


Figure 4. DART data for the January 2001 Alaska earthquake (tides removed).

Earthquake Triggers DART Buoy

The 10 January 2001 M6.9 Alaskan earthquake was an excellent example of the value of DART data to quickly confirm potentially destructive tsunamis and reduce false alarms. The earthquake occurred at 07:03 local time about 70 miles southwest of Kodiak, Alaska, and an information bulletin was issued at 07:08 by the warning center. At 07:11, a DART system at 51 deg N and 157 deg W picked up the earthquake waves that induced an apparent sea level change of approximately six cm and triggered the buoy to start transmitting 1-minute data. By 07:13 these data were plotted on the web site, and showed no tsunami present. Charles McCreery, Geophysicist-in-Charge of the National Weather Service's Pacific Tsunami Warning Center, said, "While the earthquake was too small to automatically trigger a tsunami warning, the Pacific TsunamiWarning Center closely monitored the Kodiak buoy data to quickly confirm that potentially destructive tsunami waves were not propagating towards Hawaii or the rest of the Pacific."

The Future

The NTHMP is seeking to expand the array from six DART buoys to ten buoys in order to achieve better coverage for tsunamis generated in Alaska, which pose the greatest threat to the five western U.S. states, add coverage of South America, which has generated destructive tsunamis in the past, and continue good coverage of the Cascadia Subduction Zone.

The siting strategy has required the evaluation of trade-offs between two important, but somewhat conflicting, operational requirements:

1. Early detection to maximize the time available for assessment and warning
2. Full coverage of tsunamigenic zones, with sufficient spatial resolution to estimate the directional distribution of the tsunami energy.

Figure 5 graphically illustrates these tradeoffs. A minimum of three DART measurements are required to estimate the width of the main beam of tsunami energy. Since the beam widens with increasing distance from the source, DART station spacing increases and fewer stations are required. However, the time available for assessment and warning decreases because the tsunami takes longer to reach the stations. In

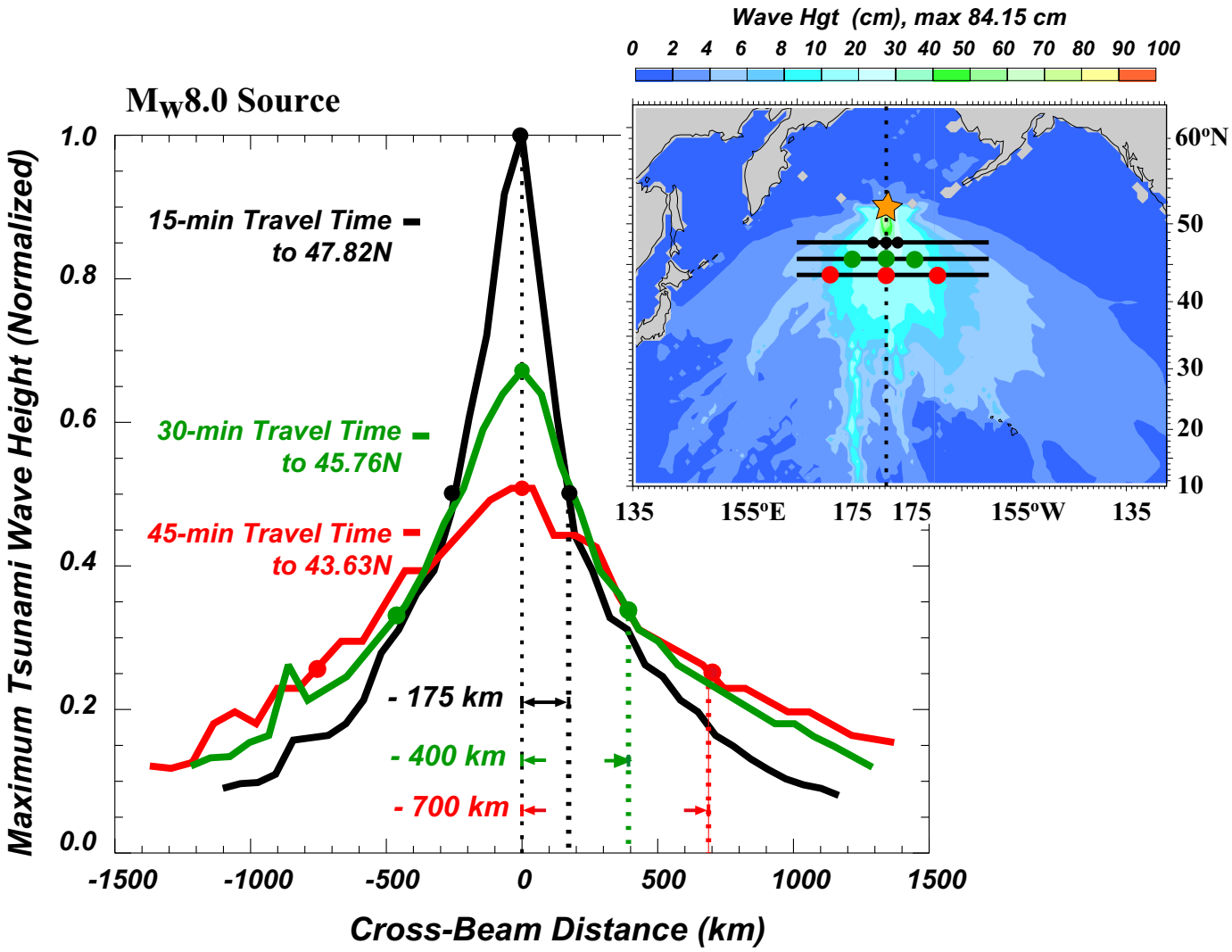


Figure 5. Trade-off between early detection and source coverage. Map shows maximum wave height model results for a magnitude 8.0 earthquake (yellow star) in Alaska, with horizontal lines indicating location of computed maximum wave height profiles, shown to left. Dots indicate hypothetical DART measurements at the "half-amplitude" points, and the dashed vertical lines suggest minimum DART station spacing required to estimate the height and width of the profile for detection 15, 30, and 45 minutes after the earthquake.

addition to these operational considerations, siting decisions are naturally constrained by the total number of stations that can reasonably be established, given practical logistical problems and budgetary realities. Currently, the cost to purchase a DART buoy is about US $250,000 and the cost to maintain a DART buoy is about US $125,000/year exclusive of ship time. About 20 days of Class I ship time are required each year to maintain the current 6-station array.

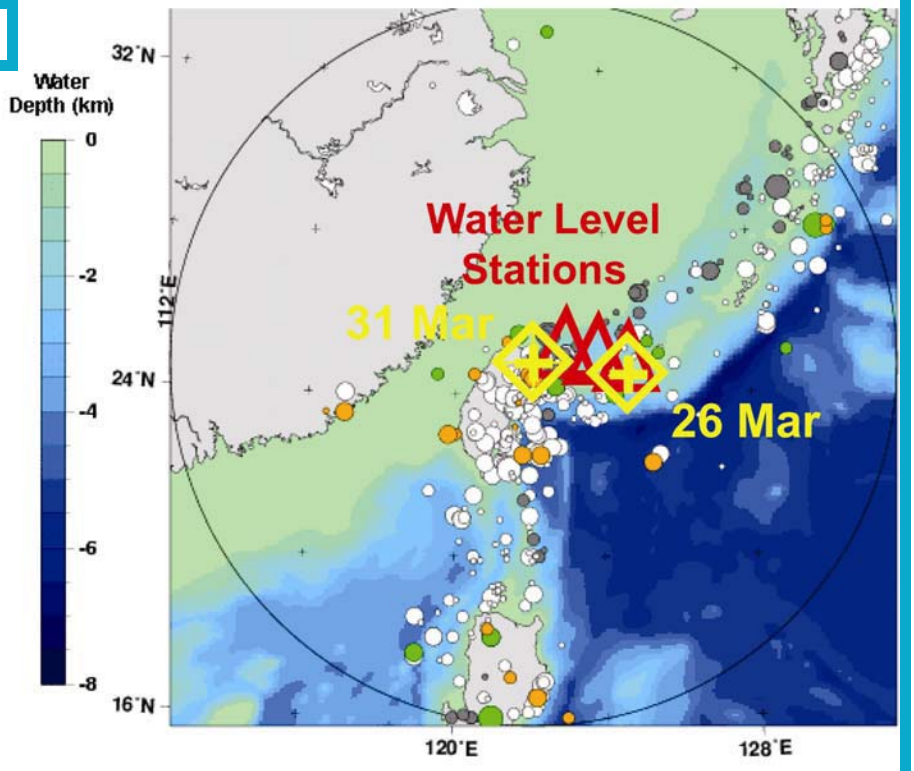
Under a joint Memorandum of Agreement between the U.S. National Weather Service Pacific Region and the Servicio Hidrografico y Oceanografico de la Armada de Chile (SHOA) to improve the Chilean sea-level monitoring system, PMEL will be installing a DART buoy at 20 deg S, 85 deg W offshore of Iquique, Chile. The DART system to be deployed will be identical to those currently deployed in the northern Pacific, and will utilize the standard DART communications systems for data transmission. When in place, the system will provide real-time confirmations of offshore tsunamis for Chile. Points of contact for this project are Dr. Eddie Bernard, Director, PMEL, and Dr. Rodrigo Nunez, Head, Dept. of Oceanography, SHOA.

26 March 2002 (con't)

Both the March 26 and March 31 earthquakes occurred beneath the ocean and were associated with the subduction of the Philippine Sea Plate beneath the Eurasion Plate; moment tensor solutions show thrust mechanisms with generally east-west or northeast-southwest fault strikes.

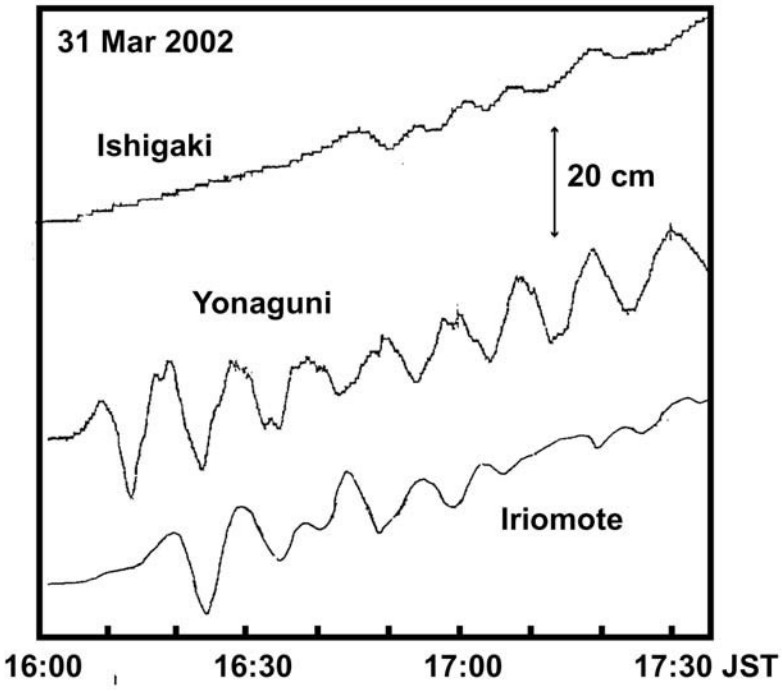
The Mw6.4 March 26 earthquake occurred several hundred kilometers to the east of the March 31 event, beneath the westernmost section of the Ryukyu Trench. The Mw7.1 March 31 Taiwan event occurred in the easternmost part of the Taiwan Collision Zone, a tectonically-complex region of frequent moderate to strong seismicity characterized in the north, by the Philippine Plate subducting northward beneath the Eurasian Plate at the Ryukyu Trench, and in the south, by the Eurasian Plate converging with the Philippine Plate and causing thrusting at the Manila Trench.

The Taiwan earthquake was felt over much of the island, and resulted in at least five deaths and 200 injuries in the Taipei area. In contrast, the devastating M7.6 1999 Taiwan earthquake that killed 2297 and injured 8700 people and occurred beneath the island and within the Eurasion Plate along a more north-south fault suggesting it was associated with plate collision in the southern



Historical seismicity within 1000 km of (24.8N 122.1E)		
Tsunamigenic	Non-Tsunamigenic	Magnitude
Distant Damage	Depth < 100 km	8 or larger
Local Damage	Depth 100-300 km	7 - 8
No Damage	Depth > 300 km	6 - 7
		Less than 6

31 March 2002 06:53 UTC Taiwan Region



Both of these earthquakes (March 26 and 31) were large enough to cause concern and immediately following the earthquakes, the Japan Meteorological Agency (JMA) issued warnings for the Miyako-shima Yayeyama Region.

On March 26, the warning was issued at 12:54 Japanese Standard Time (JST). The warning was based on preliminary information received by JMA that a magnitude Mjma 6.6 or JMA Mw 6.7 had occurred near Ishigaki-shima at an approximate depth of 8 km. The warning was cancelled at 13:30 JST, 36 minutes later.

On March 31, the warning was issued at 16:02 JST. The warning was based on preliminary information received by JMA that the earthquake was located at 24° 13.72' N and 121° 58.29' E, with a depth of 55 km and magnitude of Mjma 7.2 and Mw 7.2. The warning was cancelled 38 minutes after issuance at 16:40 JST. (The tide records on this page are also from JMA and GSIJ; for station locations see tide records for March 26 on page 2).

CONFERENCES, Con't.

Sept 10-15, **Local Tsunami Warning and Mitigation.** International Workshop organized by the IUGG Tsunami Commission (IUGG/TC) and the International Co-ordination Group for the Tsunami Warning System in the Pacific (ICG/ ITSU), Petropavlovsk-Kamchatskiy, Russia. Co-conveners are Dr. Joanne (Jody) Bourgeois (j.bourgeo@u.washington.edu) and Dr. Mikhail Nosov (psiwc47@phys.msu.su). The purpose of the workshop is to consider the current status of the local tsunami problem and to discuss fundamental and applied studies directed toward reduction of local tsunami hazard. The result of the workshop will be recommendations on strategies for local tsunami warning and mitigation. The scope of the workshop will cover: Historical Catalogues and Databases, Seismo-tectonics of tsunami, Numerical and analytical models of local tsunami behavior, Combination of local tsunamis with other dangerous oceanic phenomena, Mitigation and Counter-measures, Recent local tsunamis, Tsunami geology and paleotsunamis, Tsunami measurement and data analysis, Landslides and other sources. Participants who wish to give a presentation are required to complete a pre-registration form and submit an abstract by April 30, 2002. The homepage of the workshop is found at http://oceanc47.phys.msu.su/.

Oct 3-6, HAZARDS 2002 SYMPOSIUM Ninth International Symposium on Natural and Human-made Hazards *"Disaster Mitigation in the Perspective of the New Millennium"*, Antalya, Turkey. Natural Hazards Society Organizing Committee headed by Professor Dr. Nuray Karanci and Associate Professor Dr. Ahmet C Yalciner, Middle East Technical University, Turkey. HAZARDS 2002 is about geological, meteorological, hydrological, marine, and human-made hazards, in general, with specific topics at this symposium on: Disaster prevention, Mitigation and management, Economic, social and political aspects, Public education & preparedness, Lessons from past disasters,
Community participation in disaster mitigation, Adaptation and risk assessment, Insurance, Psychological and sociological aspects of disaster, Disaster information, Tele & local tsunamis (generation, propagation, modeling), Avalanches and snow hazards, The IDNDR and ISDR: Lessons learned & follow ups, NGO, NPO and Volunteer contributions. To learn more about the conference see the Web site: http://www.hazards2002.metu.edu.tr

October 6-20, The 1st International Training Course on Earthquake Disasters and Disaster Mitigation for Developing Countries. Beijing, China. Sponsors: Ministry of Science and Technology (MOST), Commission on Earthquake Hazard, Risk and Strong Ground Motion (SHR), IASPEI, Asian Seismological Committee(ASC), and Seismological Society of China (SSC). The course consists of four parts: lectures, practice and visits, discussion and exchanges, and summary. Participants will present papers to the training session, and a seminar will address developing national seismic observation systems and countermeasures and experiences in seismic hazard mitigation. Qualified papers will be published in English in the special volume of the peer-reviewed, regional journal *Earthquake Research*. For more information, contact: Su, Xiao-Lan, 5 Minzudaxuenan Road, IGCSB, Beijing 100081, China; tel: 86-10-6846-7978; fax: 86-10-6841-5372; e-mail: suxl@eq-igp.ac.cn; or http://www.icce.ac.cn/most/workshop.htm.

INTERNATIONAL TSUNAMI INFORMATION CENTER - ITIC

Located in Honolulu, the **International Tsunami Information Center (ITIC)** was established on 12 November 1965 by the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO). In 1968, IOC formed an International Coordination Group for the Tsunami Warning System in the Pacific (ICG/ ITSU). The present 25 Member States are:

Australia, Canada, Chile, China, Colombia, Cook Islands, Costa Rica, Democratic People's Republic of Korea, Ecuador, Fiji, France, Guatemala, Indonesia, Japan, Mexico, New Zealand, Nicaragua, Peru, Philippines, Republic of Korea, Samoa, Singapore, Thailand, Russian Federation and the United States of America.

http://www.shoa.cl/oceano/itic/frontpage.html (Chile site)

http://www.prh.noaa.gov/itic/ (USA site)

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